E-NSGA-II FOR MACHINING PROCESS PARAMETERS OPTIMIZATION

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Especially dedicated to:

To my beloved husband, Mohd Asri bin Ahad

My lovely parents, Yusoff Bin Ahmad @Mohd Rejab and Baidah Binti Yahaya

My cuties, Hazmi Aniq Bin Mohd Asri and Hazmi Afiq Bin Mohd Asri

For their understanding, support, encourages, pray and time.

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ABSTRACT

Optimization of machining process parameters is important to improve the machining performances. There are two consecutive ways to improve the machining performances namely modeling followed by optimization. In this study, modeling technique, namely regression is used to develop the machining model and optimization technique, multi objective genetic algorithm (MoGA) to optimize the machining process. Known as a popular MoGA, non dominated sorting genetic algorithm II (NSGA-II) is able to produce many sets of solutions with good spread of solutions from the Pareto optimal front in one time run. However, the confusion of selecting the best solution has led to the idea of using genetic algorithm (GA) and weight sum average (WSA) based as the preference points for NSGA-II. In this study, GA, WSA and combination of GA-WSA are selected as point to direct the best solutions among Pareto optimal front of NSGA-II. The machining processes for this study are cobalt bonded tungsten carbide electrical discharge machining and powder mixed electrical discharge machining. Surface roughness and material removal rate are the machining performances considered. GA-NSGA-II, WSA-NSGA-II and GA-WSA-NSGA-II known as enhanced NSGA-II (E-NSGA-II) are proposed. Two datasets from previous studies are used in this study. The results are compared with the previous studies and statistical analyses are performed to describe the significant of techniques proposed. In conclusion, E-NSGA-II is an improved technique that can increase the ability to provide best sets of optimal solutions and better stable process parameters values based on selected performance measurements compared to the previous techniques proposed.

ABSTRAK

Pengoptimuman parameter proses penting dalam membaiki pencapaian pemesinan. Terdapat dua kaedah berturutan bagi meningkatkan pencapaian pemesinan; dinamakan pemodelan dan pengoptimuman. Dalam kajian ini, teknik pemodelan, regresi digunakan untuk membangunkan model pemesinan dan teknik pengoptimuman, algoritma genetik pelbagai objektif (AGPO) untuk mengoptimum proses pemesinan. Dikenali sebagai salah satu AGPO yang terkenal, algoritma genetik tidak terdominasi II (AGTT-II) boleh menghasilkan banyak set penyelesaian pada satu masa yang sama dengan penyerakan Pareto yang baik. Namun begitu, kekeliruan dalam memilih set-set penyelesaian terbaik telah mencetuskan ide untuk menggunakan algoritma genetik (AG) dan purata jumlah berpemberat (PJB). Dalam kajian ini, AG, PJB dan gabungan AG-PJB digunakan sebagai titik rujuk dalam pencarian set-set penyelesaian terbaik. Proses pemesinan ialah nyahcaj elektrik tungsten karbida bersalut kobalt dan nyahcaj elektrik bercampur serbuk. Kekasaran permukaan (KP) dan kadar pengurangan bahan (KPB) dipertimbangkan sebagai pencapaian pemesinan. AG-AGTT-II, PJB-AGTT-II dan AG-PJB-AGTT-II dikenali sebagai AGTT-II dipertingkat (AGTT-II-D) dicadangkan. Dua set data daripada kajian sebelum ini digunakan untuk kajian ini. Keputusan yang diperolehi dibandingkan dengan hasil kajian sebelum ini dan analisa statistik dilaksanakan bagi menggambarkan kepentingan teknik yang dicadangkan. Sebagai kesimpulan, didapati bahawa AGTT-II-D ialah teknik diperbaiki yang boleh meningkatkan kebolehan menyediakan set-set penyelesaian terbaik dan nilai parameter proses yang lebih stabil berdasarkan kepada kadar prestasi yang dipilih berbanding dengan teknik-teknik yang pernah dicadangkan sebelum ini.